

SPACAL Test beam comparison in sPHENIX simulation

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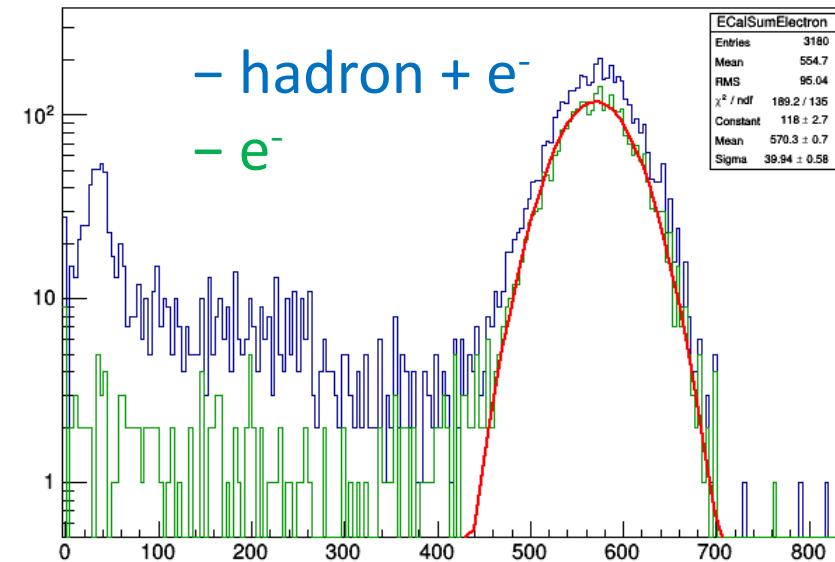
many thanks to

- Oleg Tsai
- Alex Kiselev
- Craig Woody

Overview

- ▶ One of the long last concern is lack of beam test calibration for our simulation
- ▶ Obtained eRD1 2014 beam test geometry and data with many help from Oleg Tsai, Alex Kiselev and Craig Woody
- ▶ Implemented in Geant4 -> SPACAL towering -> digitization

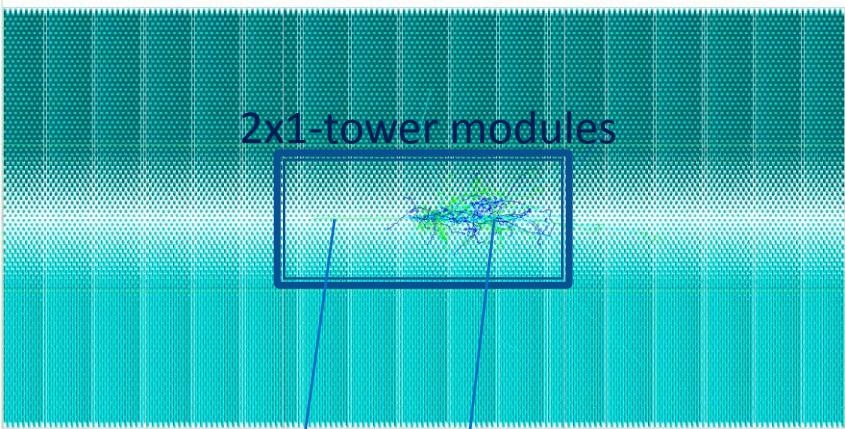
SPACAL prototypes in 2014 Fermilab beam test



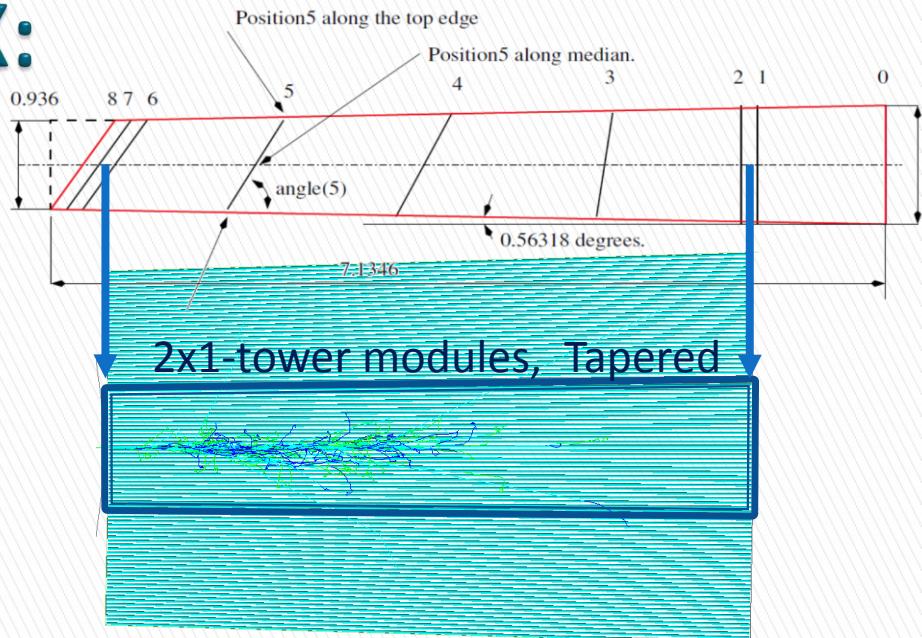
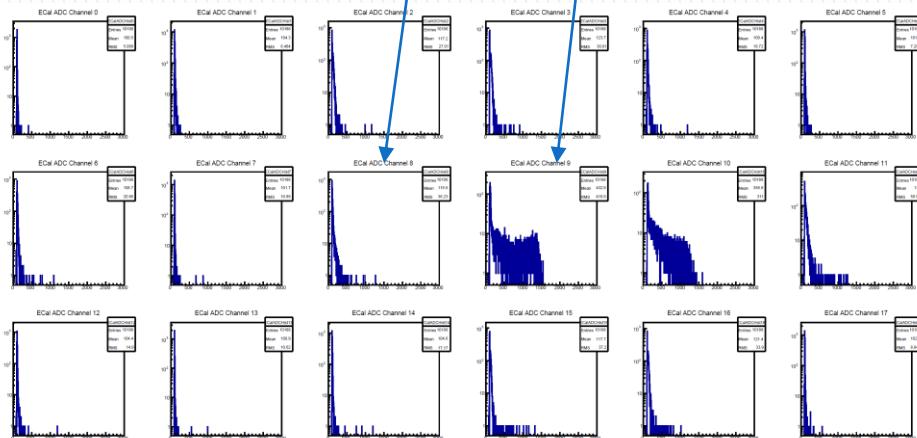
Courtesy : O. Tsai (UCLA)

Test beam in sPHENIX:

More detailed views of fibers
(ϕ 500um double cladding)



Particle view
(half cm front Al cover not shown)



Side views
(17 degree indenting as in test beam, 2.4-2.7% energy spread and half-cm front Al cover not shown)

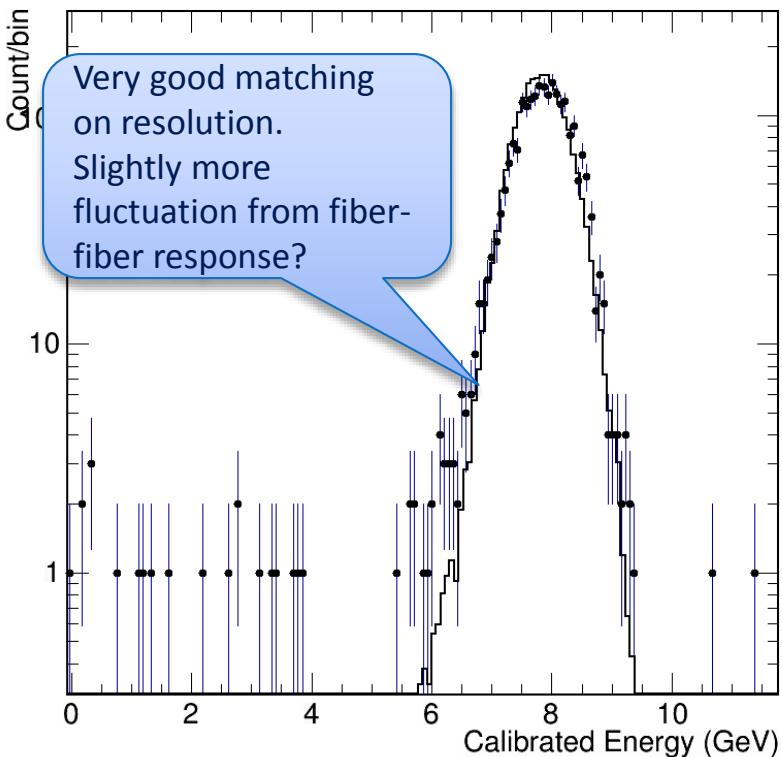
Further refine the simulation VS reality

New from last week

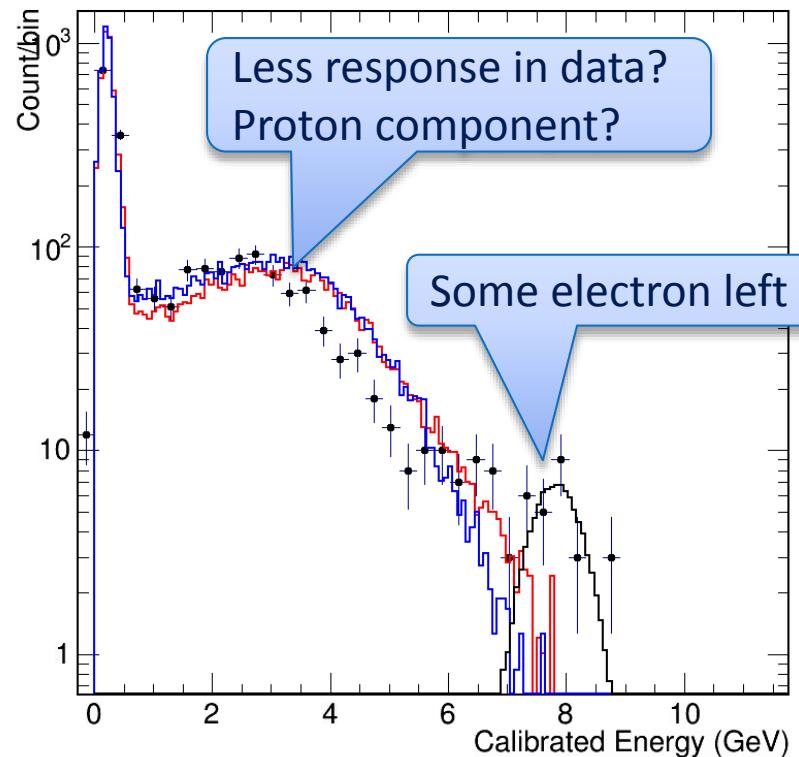
- ▶ Implemented the beam momentum spread
 - 2.4% for 8 GeV/c beam, 2.7% for 4 GeV/c beam
- ▶ Baseline simulation configuration (same as 3rd iteration of production):
 - Hadronic model: QGSP_BERT_HP
 - Light production: Geant4 default Birk model (G4EmSaturation::VisibleEnergyDeposition)
 - Group Geant4 hits into fibers then into towers
 - Digitalization with test beam performance:
 - photon fluctuation (500e/GeV, Poisson model)
 - Pedestal noise (2ADC)
 - Zero suppression of (4ADC)
- ▶ Comparison to three tunes of the hadronic model
 - Our baseline
 - Tuning of the production threshold
 - Alex K.'s study used a 1um production threshold cut in EICROOT simulation.
 - Tested in our software
 - Use of the CALICE Birk constant

Test beam comparison: 8 GeV beams shower in Geant4 VS data

Electron Sim (line) VS data (point)



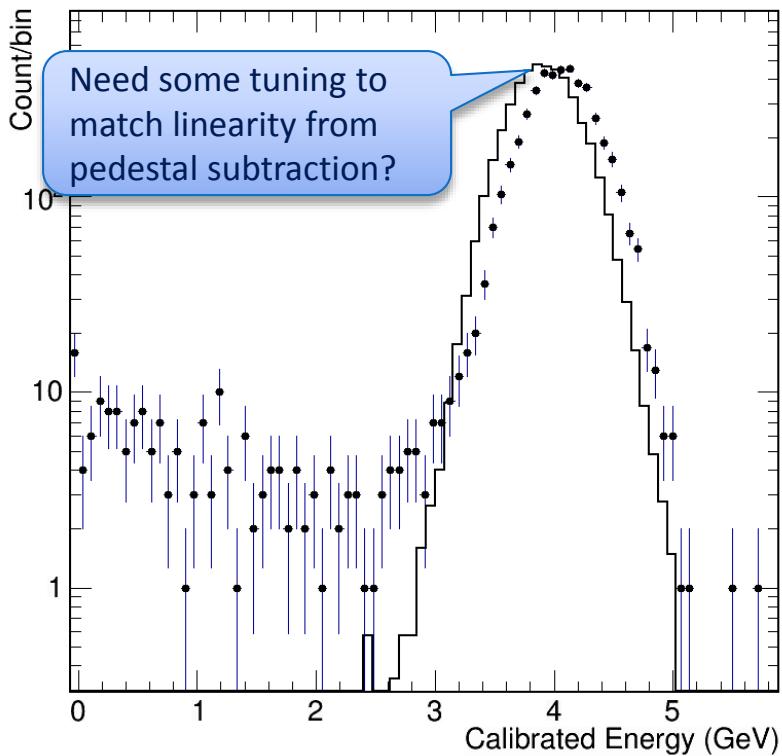
Pion- (red) K- (blue) e contain. (black) Sim VS data



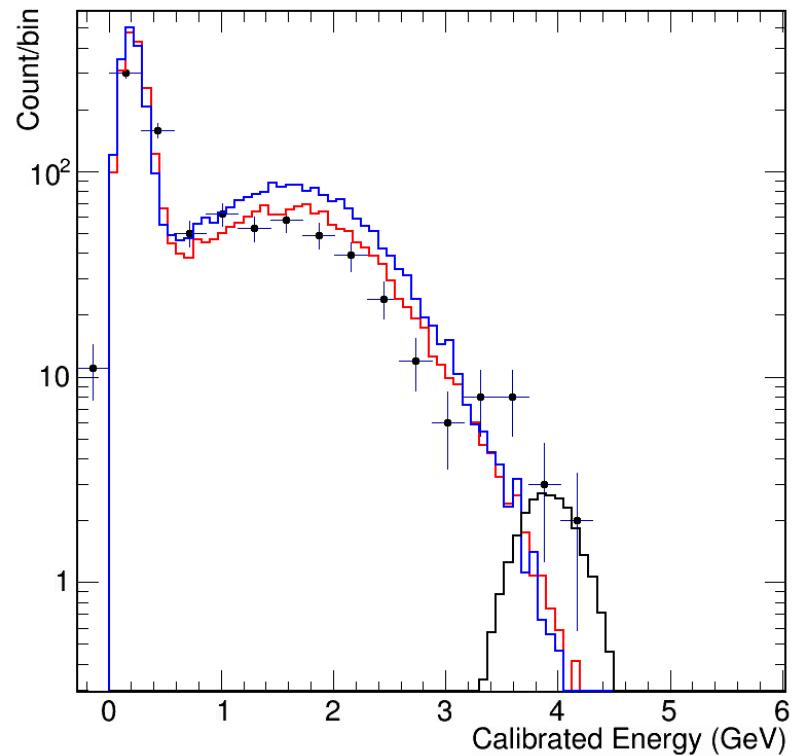
Full Geant4 sim QGSP_BERT_HP + light yield model (Geant4 default Birk)
Pedestal noise (2ADC), photon fluctuation (500e/GeV), NO fiber/fiber response

Test beam comparison: 8 GeV beams shower in Geant4 VS data

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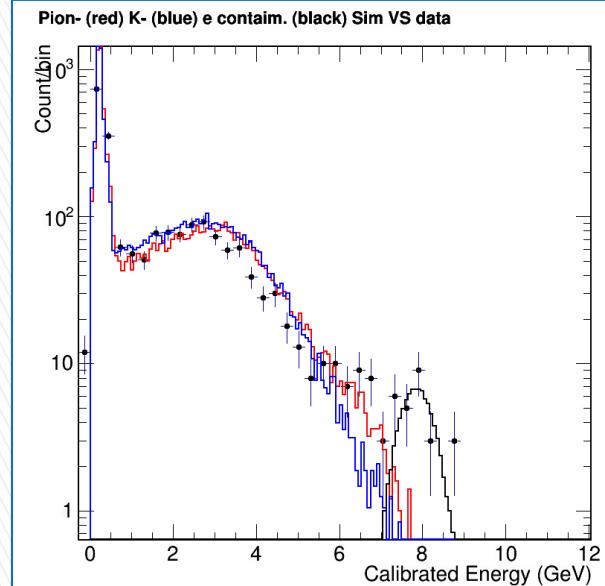
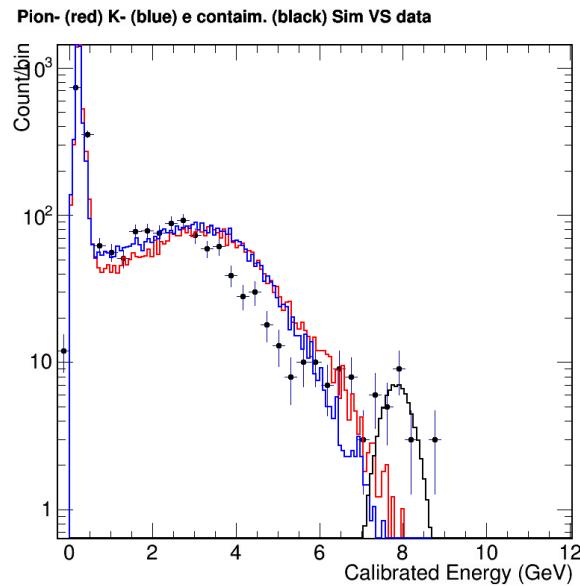
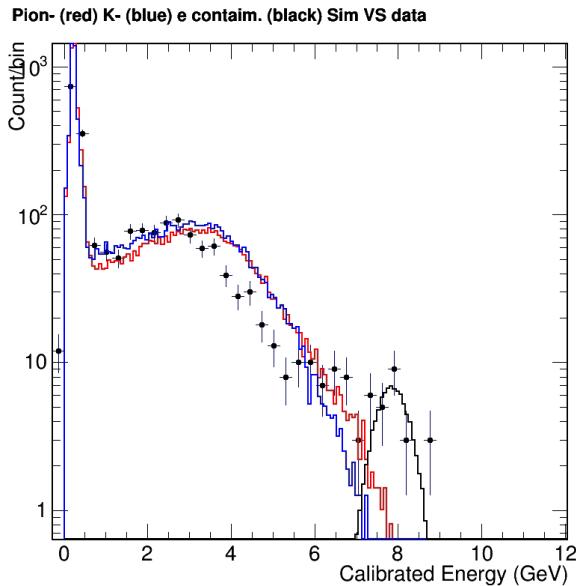


Full Geant4 sim QGSP_BERT_HP + light yield model (Geant4 default Birk)
Pedestal noise (2ADC), photon fluctuation (500e/GeV), NO fiber/fiber response

Hadronic model tuning comparison

8 GeV hadron-cut data VS sim shown

More plots in backup



Default configuration

Baseline config
+ production threshold of 1um

Baseline config
+ CALICE Birk constant
0.0151 cm/MeV

Next step

- ▶ Use the test beam data comparison in pre-CDR line-shape plot as simulation justification.
- ▶ Use the same towering -> digitalization strategy in pre-CDR analysis
- ▶ Discussion: strategy to save/pass down tower information:
Geant4 RawTower -> Digitalized Tower -> Calibrated Tower -> Clustering/Jet Finding

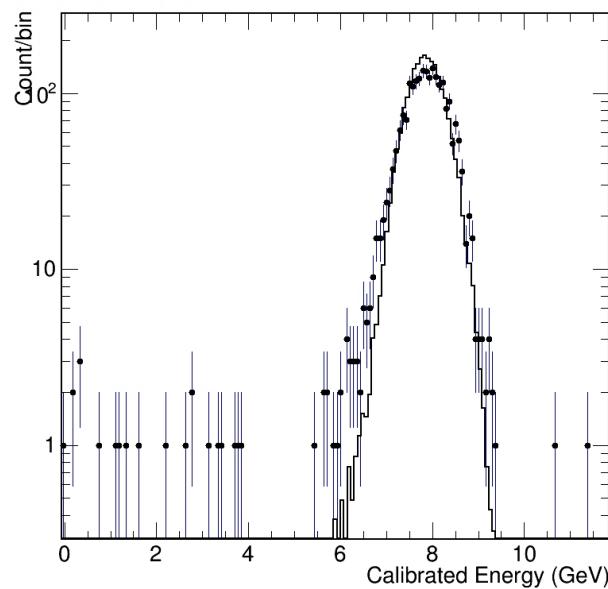
Extra information



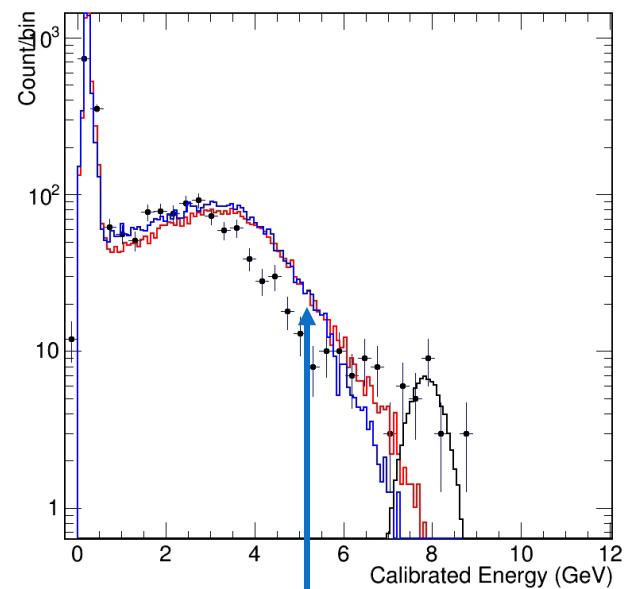
8 GeV beams VS Production threshold

Geant4 Default
production
threshold (1mm)

Electron Sim (line) VS data (point)

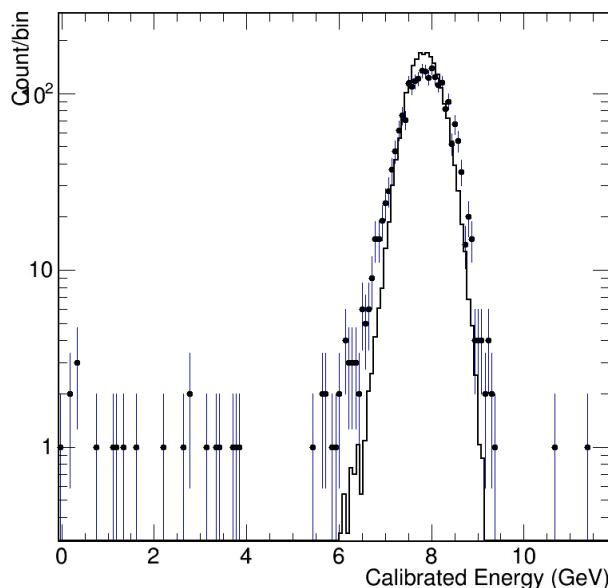


Pion- (red) K- (blue) e containm. (black) Sim VS data

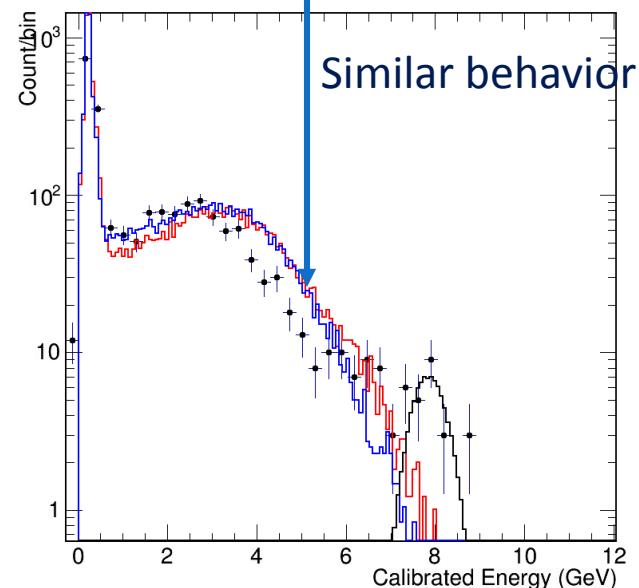


Production
threshold cut
(1um)

Electron Sim (line) VS data (point)



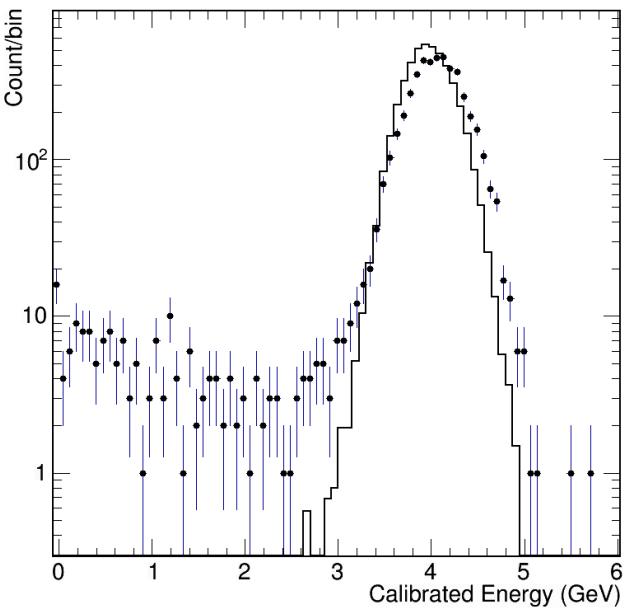
Pion- (red) K- (blue) e containm. (black) Sim VS data



4 GeV beams VS Production threshold

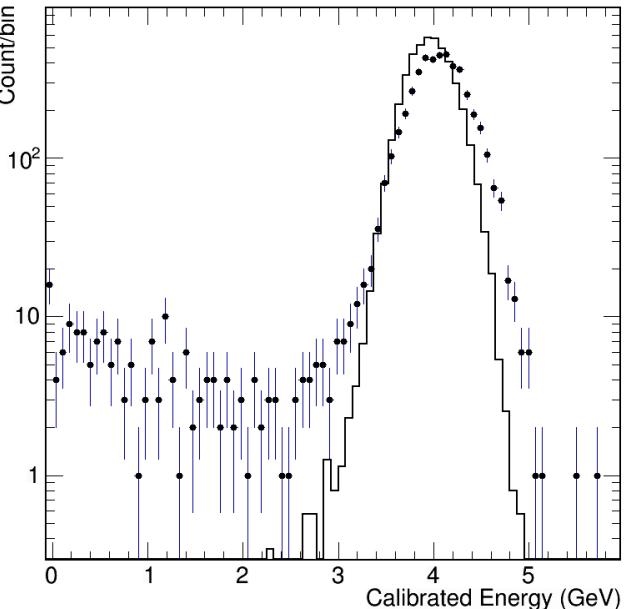
Geant4 Default
production
threshold (1mm)

Electron Sim (line) VS data (point)

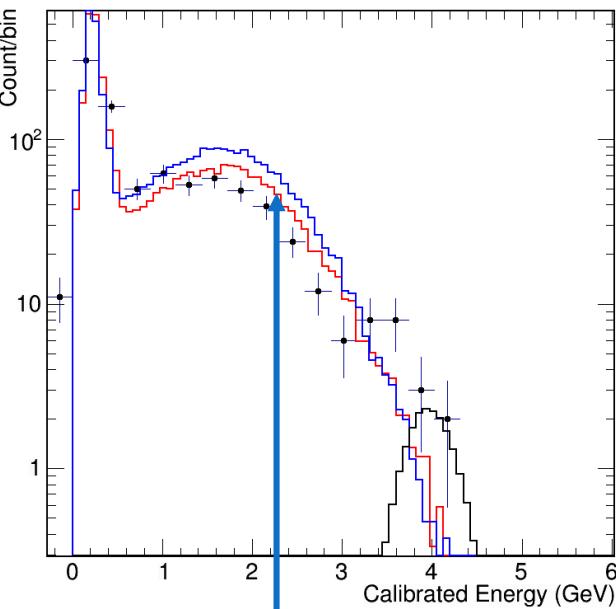


Production
threshold cut
(1um)

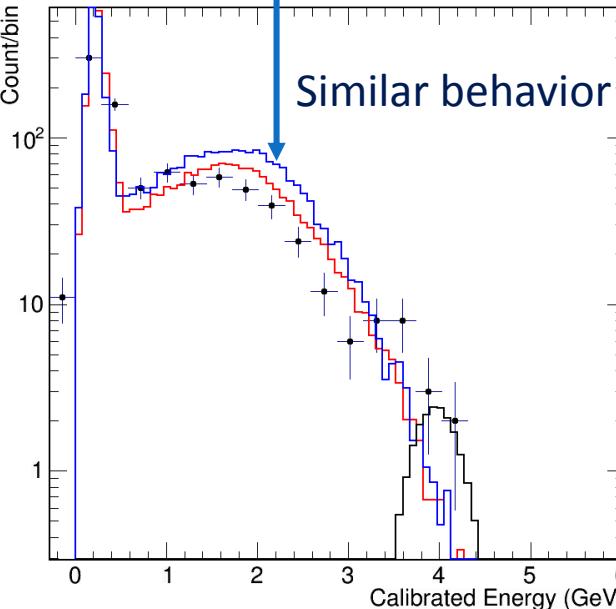
Electron Sim (line) VS data (point)



Pion- (red) K- (blue) e containm. (black) Sim VS data

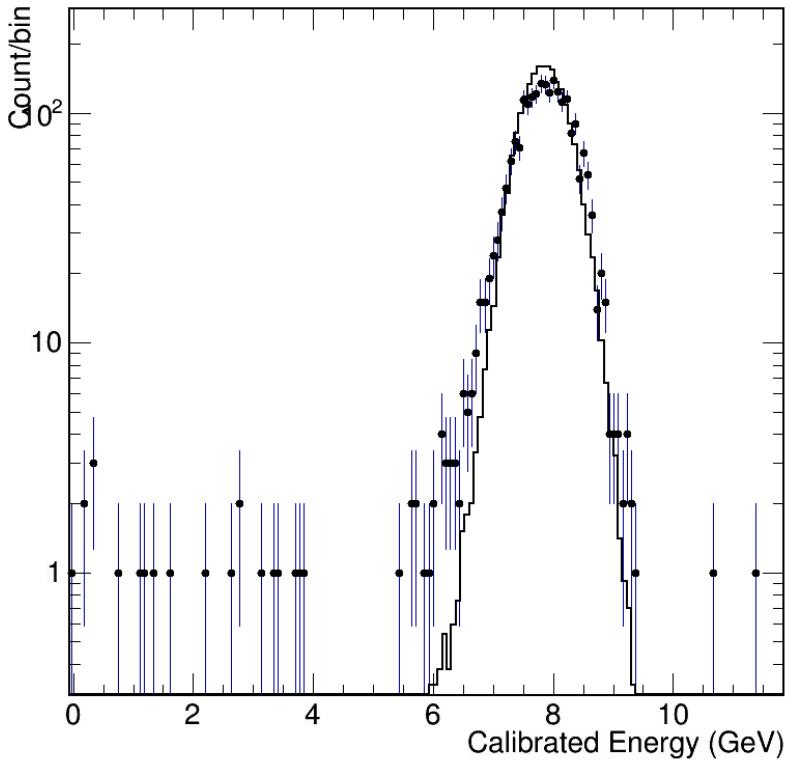


Pion- (red) K- (blue) e containm. (black) Sim VS data

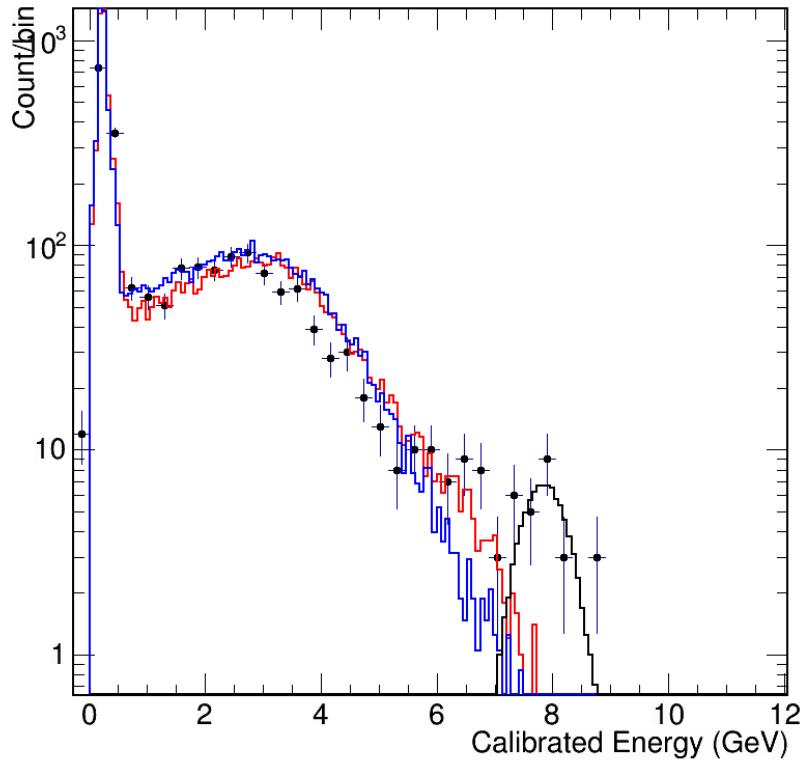


CALICE Birk Constant

Electron Sim (line) VS data (point)

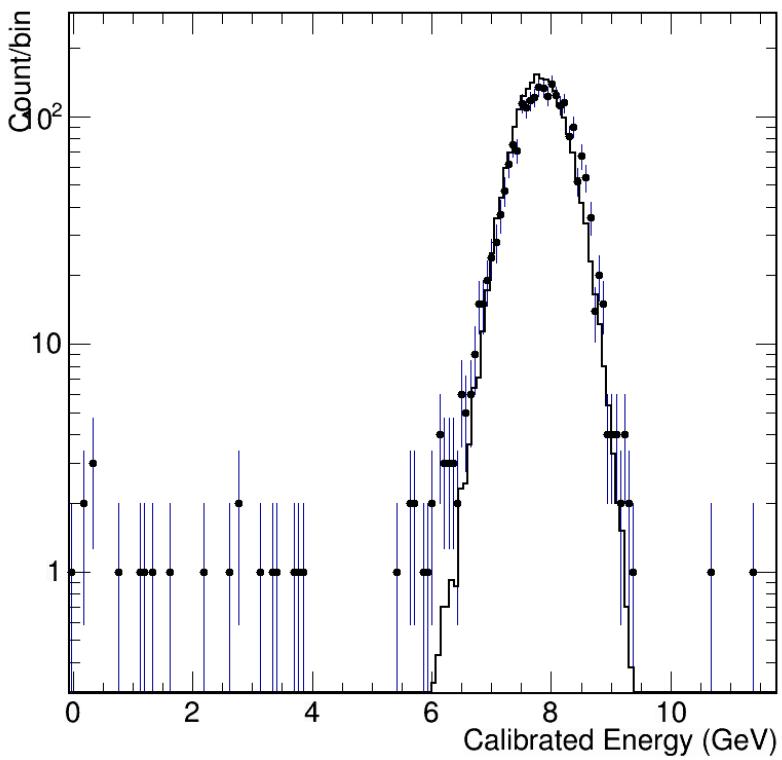


Pion- (red) K- (blue) e containim. (black) Sim VS data



CALIC + Towering

Electron Sim (line) VS data (point)



Pion- (red) K- (blue) e containm. (black) Sim VS data

